

Landsat Science Team

Landsat Operations Report

26 July 2016

Brian Sauer

USGS EROS

bsauer@usgs.gov

Agenda

- **Mission and Acquisition Status (L7,L8)**
- **Archive Status**
- **LGAC Status**
- **Distribution and Collection Management Status**
- **L7/L8 Acquisition Status**

Mission Status

▪ Landsat 7

- Acquiring at a rate of ~470 scenes/day with continental acquisition strategy
 - Implemented 105% duty cycle for ETM+ in order to increase data acquisition in support of Northern Hemisphere growing season imaging, along with increased acquisitions over the African Continent and Central America
 - No spacecraft anomalies since the winter science team meeting
- Conducting end of mission planning – targeting overlap with Landsat 9 launch readiness
 - Considering extended mission life potential (July 2021)

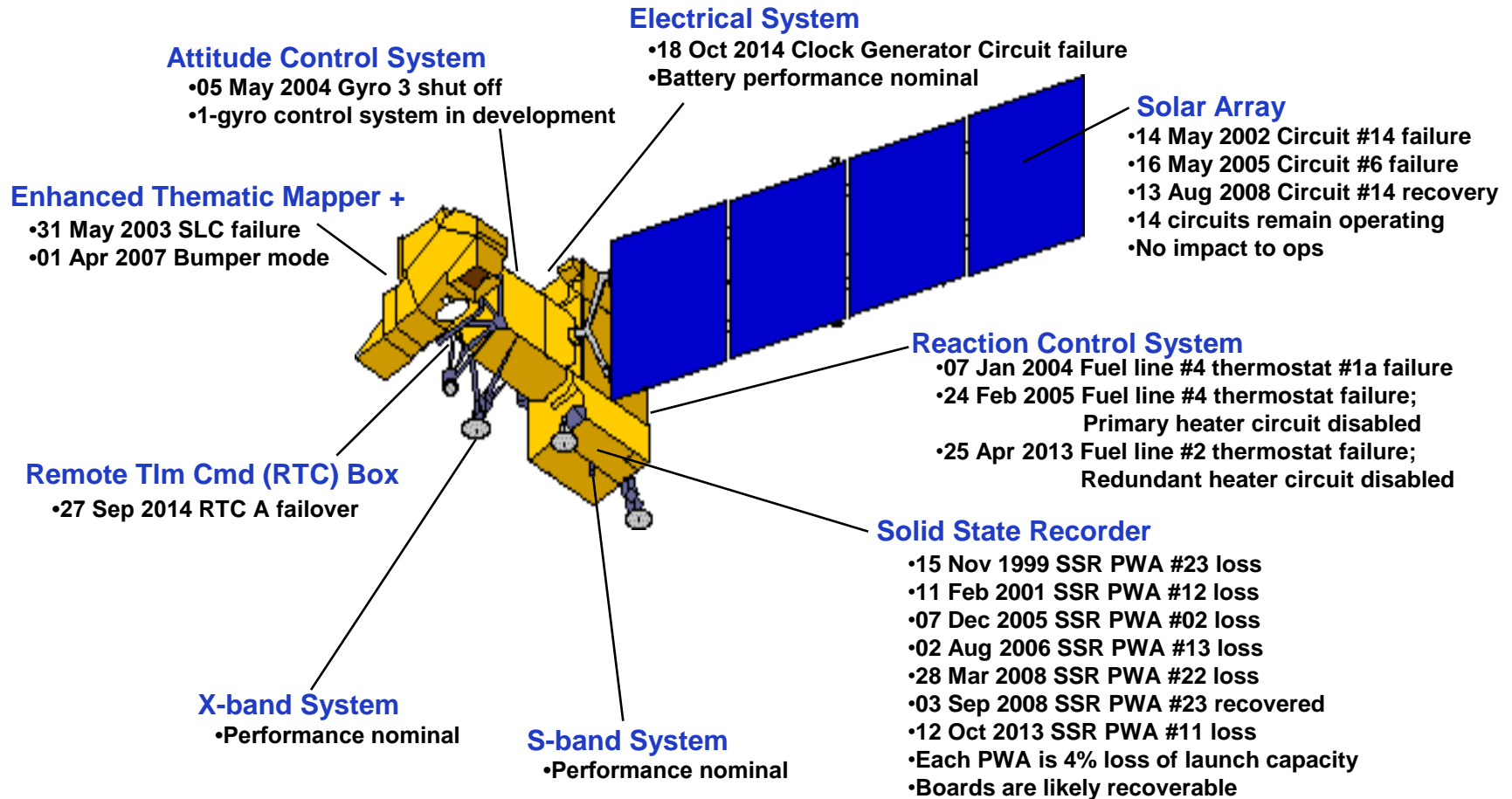
▪ Landsat 8

- On-orbit performance of Landsat 8 observatory continues to be outstanding; acquiring up to 740 plus scenes per day
 - Mission data management effective - on-board recorder averaging 70% margin
- TIRS Scene Select Mirror (SSM) Encoder Circuit B-side alternative operations concept performing well
 - Science data processing updates in support of TIRS processing complete



Landsat 7 Observatory Status

~ 17+ years of on-orbit operations



L7 End Of Mission Planning

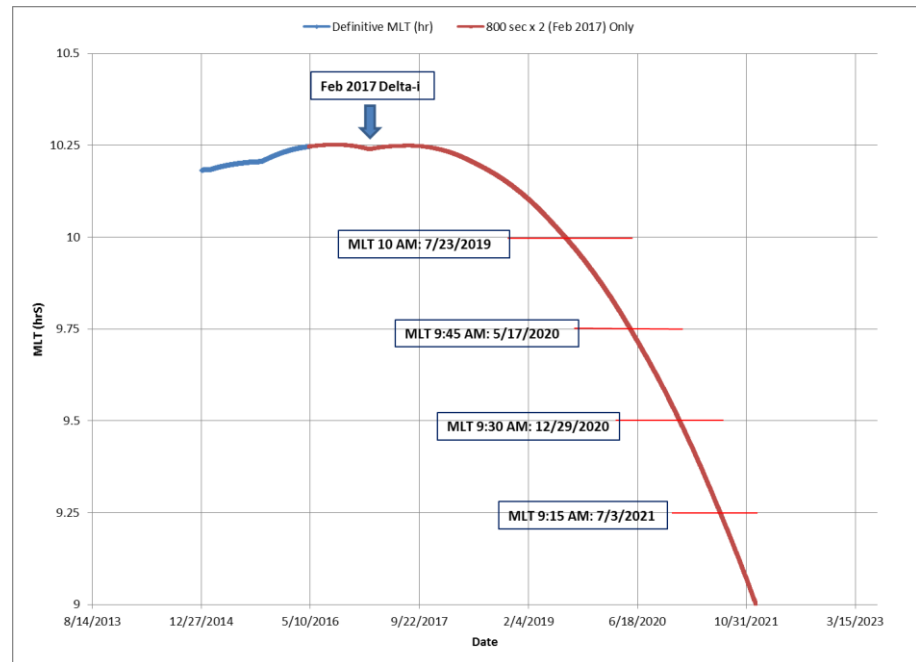
- Landsat 7 End of Mission planning is in-progress
 - Ideally end of mission is driven by fuel availability and disposal orbit requirement
 - Spacecraft or instrument anomalies may also result in premature end of science mission
- Concurrence received by Landsat Science Team (LST) for 9:15 MLT crossing for end of science mission
 - Science goal is to minimize operational gap between demise of L7 and initiation of L9 operations
- Assuming spacecraft and instrument health and safety are not factors, project has developed an optimized approach to maximize 8-day repeat coverage
 - Orbit lowering target of 8km to disposal orbit of 697km in order to ensure stewardship of orbit
 - Fuel reserves used to lower perigee to maximize drag potential
 - Maximizes potential to overlap with Landsat 9 LRD & commissioning
 - Extends science mission potential to July 2021 based on acceptance of 9:15 MLT crossing
 - Will lower at Landsat 9 LRD minus two months or following under-fly of Landsat 9 if desired assuming launch is prior to July 2021

Current approach stretches Landsat 7 science operations by an additional year to July 2021 thereby maximizing potential to overlap with Landsat 9 operations



Adopted Approach – Maximizing 8-Day Coverage

- Align with L9 - Extend Landsat 7 science mission operations as close to Landsat 9 LRD as possible
- Determine highest possible safe disposal orbit (A-Train “exit orbit” determined to be down 4km or 701km of altitude)
 - Exit orbit is not necessarily the same as disposal orbit
 - Discussed during A-Train Mission Operations Working Group (MOWG) in April
 - MOWG has not yet defined minimum disposal orbit
 - MOWG urged lower disposal orbit be considered by USGS
 - Project recommending 8km drop to disposal orbit of 697km
 - Fuel reserve allows for perigee burn to maximize orbital drag and decay
- Proposed approach allows for 1 additional inclination maneuver (delta-I) in Feb 2017
 - 9:45 AM MLT May 2020
 - 9:30 AM MLT December 2020
 - 9:15 AM MLT July 2021
 - Lower ~8km following crossing of 9:15 AM MLT or proximity to Landsat 9 LRD to ~697km (approximately 4kg of fuel margin projected)



800 sec x 2 (Feb 2017) Only	Peak MLT (10:15:04 AM)	9/4/2016	Fuel Remaining on MLT Crossing Date (kg)	After 8 km Lowering (kg)
	10:00 AM MLT Crossing	7/23/2019	8.23	4.33
	9:45 AM MLT Crossing	5/17/2020	8.20	4.30
	9:30 AM MLT Crossing	12/29/2020	8.18	4.28
	9:15 AM MLT Crossing	7/3/2021	8.17	4.27

Represents best chance to align and potentially overlap with Landsat 9 LRD & commissioning



L7 Next Steps

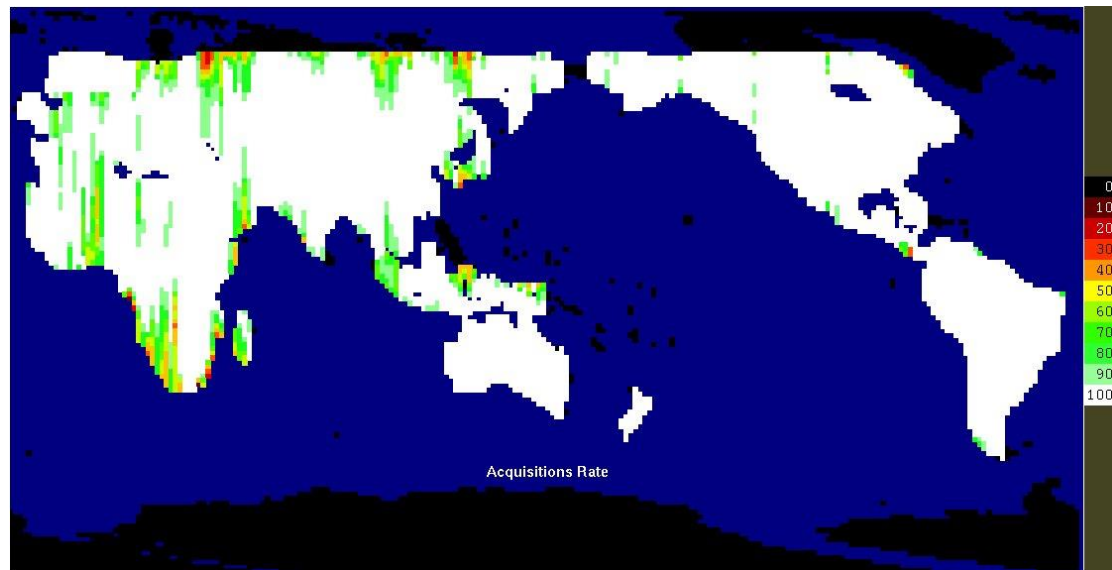
- **Update fuel analysis and refine 9:15 AM equatorial crossing**
 - Independent study performed by NASA
 - Final docs being submitted (nearly complete)
- **Confirm with Landsat 9 Project expectation to lower LRD minus 2 months or following Landsat 9 under-fly (if desired)**
 - Justification being worked through Landsat Project Science
- **Completed first draft of Landsat 7 End of Mission Plan (EOMP) July 2016**
 - Revise and update EOMP as required by August 2016
- **Support Restore L planning and preparation for Mission SRR scheduled for August 2016**
 - *Will not impact science mission*

Landsat 7 Acquisition Goals

- **Tune Landsat 7 Continental Model**
 - Acquire as many images as possible
 - Acquire the best possible images
 - Do nothing to shorten the mission
- **Reduce duty cycle rejections by relaxing constraints**
 - Duty constraint raised to 105% of current (1 March)
 - Careful monitoring of telemetry
 - Duty cycle rejections tend to shift to memory rejections
- **Increase download opportunities**
 - Add International cooperators as “bent-pipe” LGN stations
 - Adds operational margin in anticipation of future memory board losses or loss of LGN station

Landsat 7 Acquisition Models

- Relax ETM+ duty cycle threshold to 105% on 1 March
- Current LGN contacts
- Benefits
 - 15 additional scenes/day
 - Fewer power cycles
- Costs
 - More SSR rejects



Daily Average Metrics	Baseline
Acquisition Rate (LGN)	460 scenes/day (93.4% of candidates)
ETM+ duty cycle	15.0%
ETM+ power cycles	17.9
SSR Capacity Rejects	0.23
ETM+ Duty Cycle Rejects	31.5

Daily Average Metrics	Relaxed Duty Cycle Constraints
Acquisition Rate (LGN)	475 scenes/day (96.5% of candidates)
ETM+ duty cycle	15.4%
ETM+ power cycles	17.3
SSR Capacity Rejects	1.75
ETM+ Duty Cycle Rejects	15.0

2



Landsat 8 Observatory Status

[~3 years of on-orbit operations](#)

[RF Communications](#)

S-band System

X-band System

[Thermal Control System](#)

[Propulsion Subsystem](#)

[Attitude Control System](#)

[Electrical Power System](#)

Batteries

Solar array

Operational Land Imager



Thermal Infrared Sensor

October 2014 – Side-A SSM Encoder

September 2015 – Encoder Side-B current fluctuations

January 2016 – Implemented Alternative Operations Concept B-Side

Effective 4/2016 TIRS data processed along with OLI

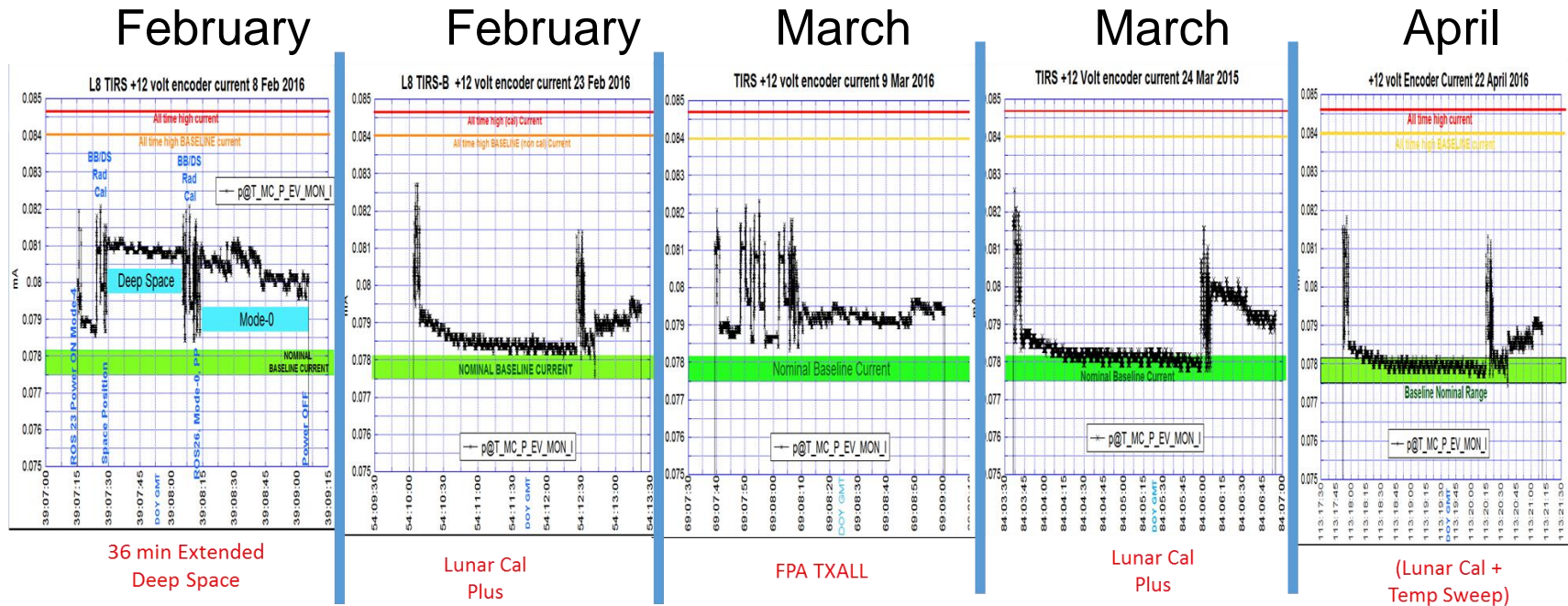
[Command & Data Handling System](#)

Solid State Recorder – File Delete (ghost file) errors

– Successfully corrected in September 2015

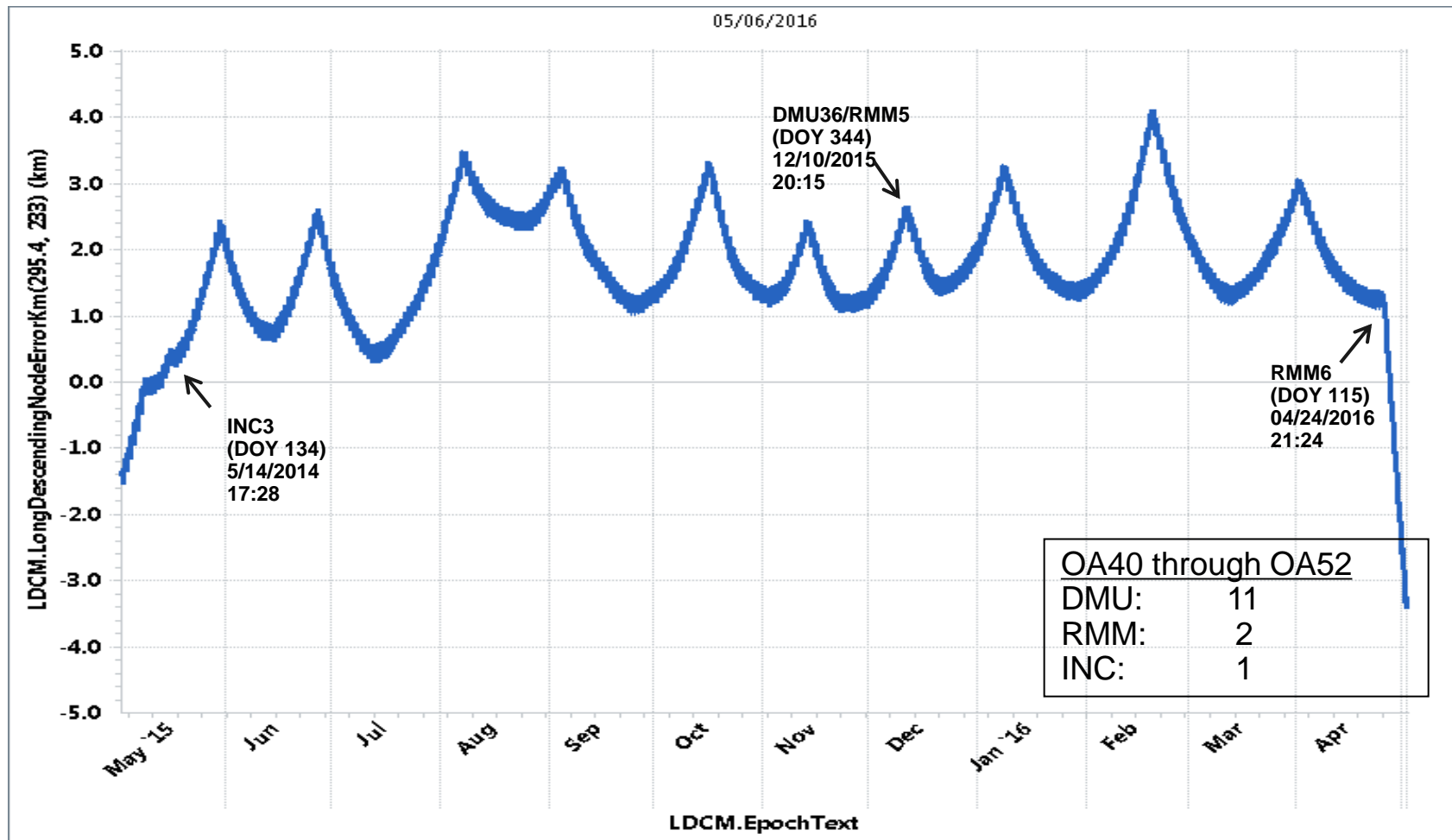


TIRS B-Side Encoder Current



Alternative operations concept is performing well!

Landsat 8 WRS-2 Error (1 year)

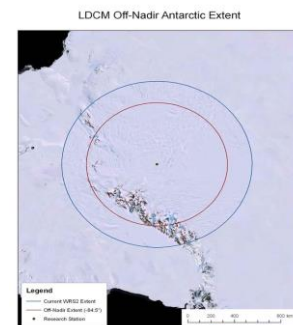
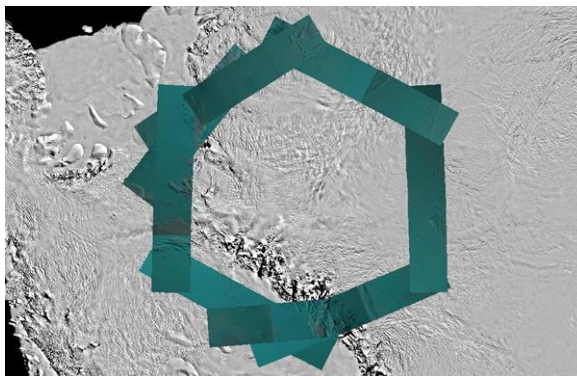


*RMM6 set L8 in a path to move out of specification within 5 days of the maneuver.
Able to recover through inclination maneuver that was rescheduled within a week of RMM6*

Antarctic and Arctic Off-Nadir Requests

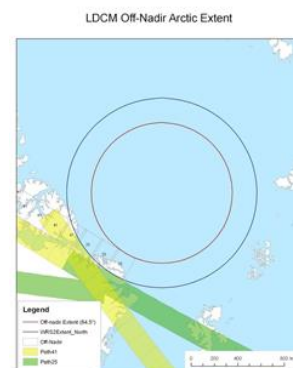
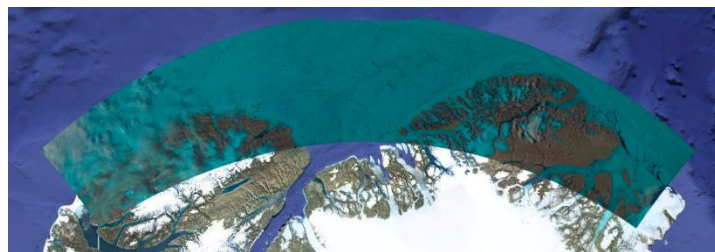
- **Antarctica (Complete Feb 2016)**

- 6 off-nadir paths 60 degree steps
- 2 off-nadir paths to cover ends of Transantarctic Mountains
- Expect to repeat variation annually
- *No impact to routine image acquisition*

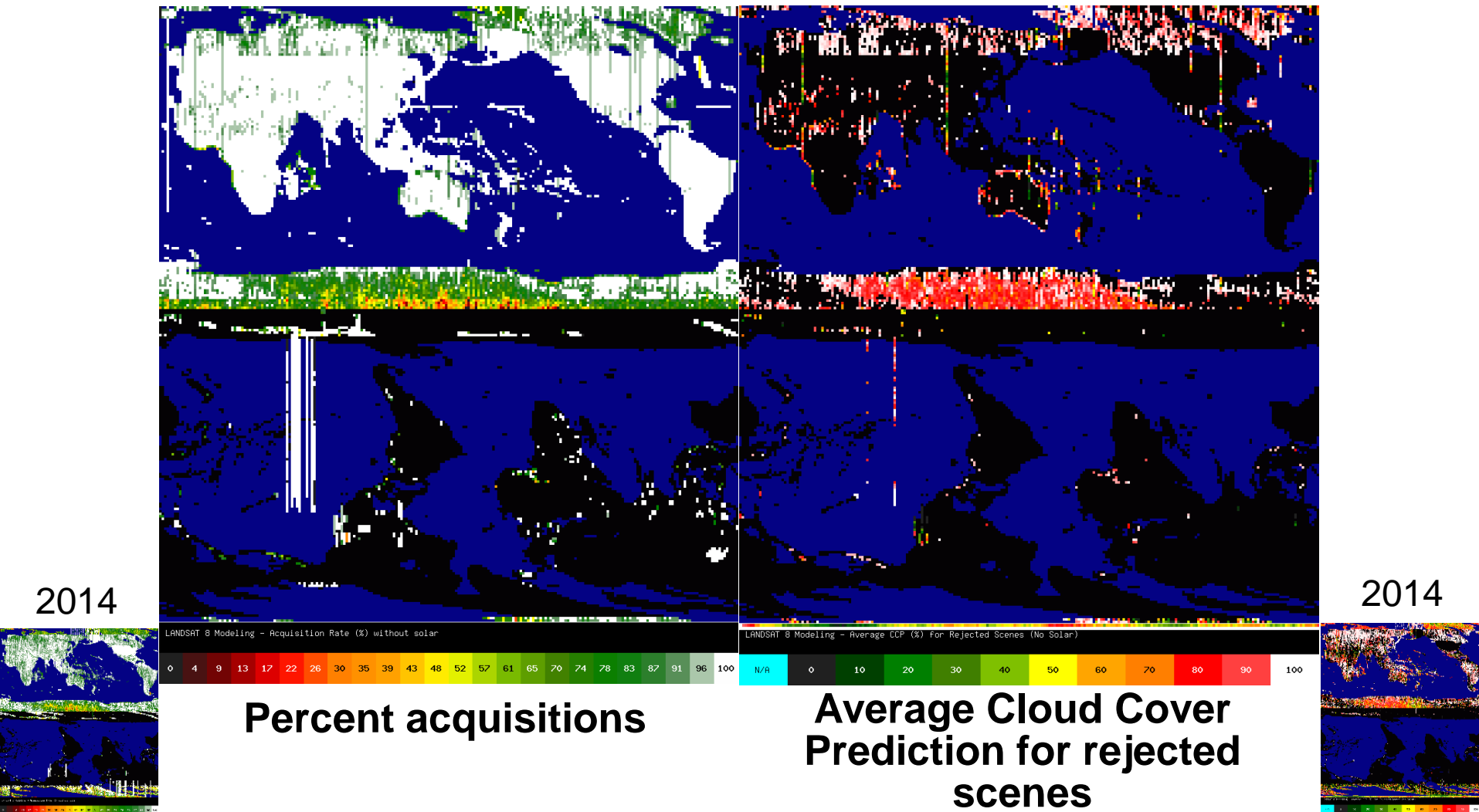


- **Arctic (Jul-Aug 2016)**

- 1 off-nadir path
- Impacts Canada and Scandinavia, but with 8 day ascent & descent revisit time
- *No impact to routine image acquisition anticipated*

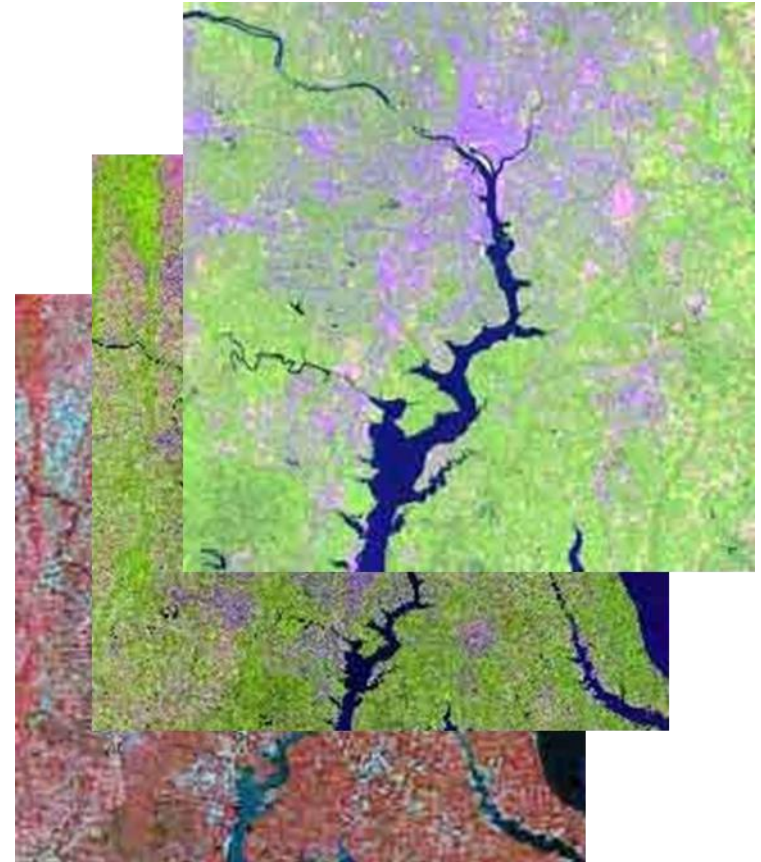


Landsat 8 Acquisitions - 2015

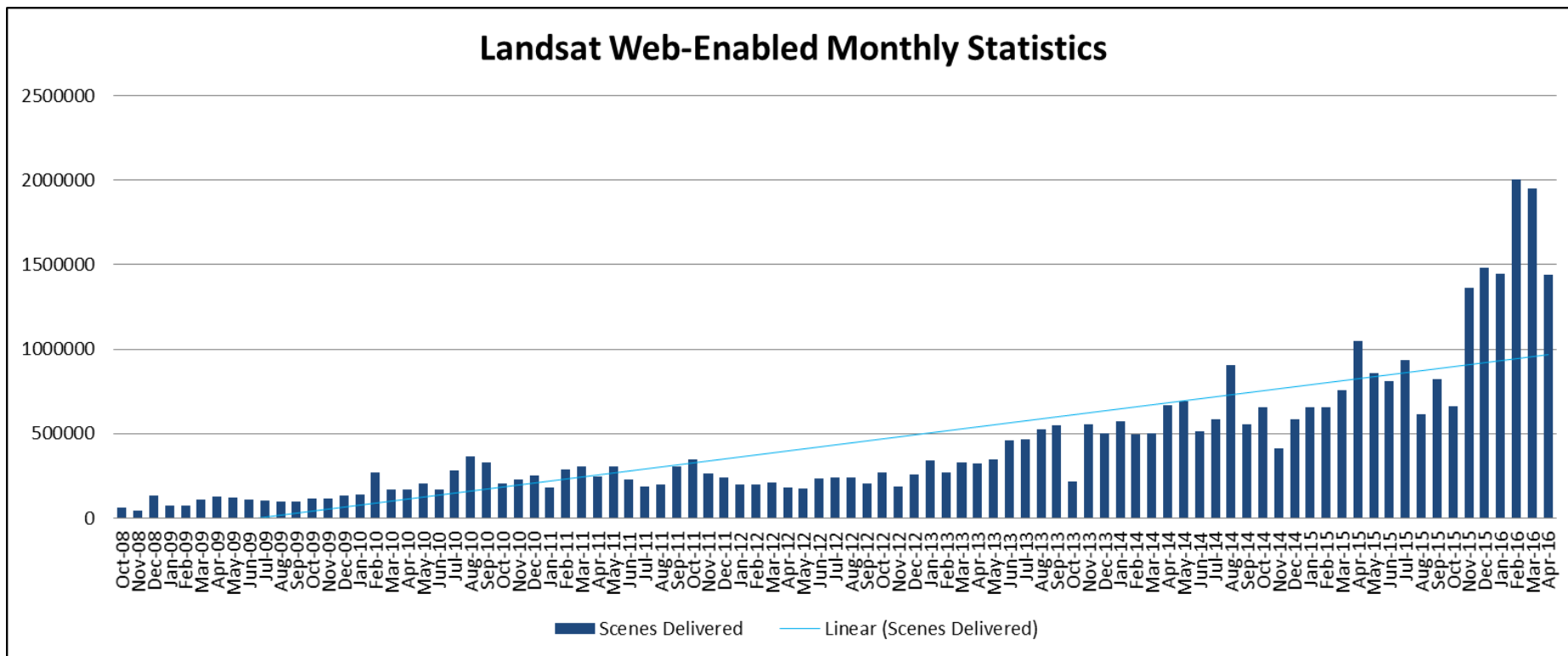


U.S. Landsat Archive Overview (May 2, 2016)

- **OLI-TIRS: Landsat 8**
 - ◆ **725,534** scenes
 - ~ 2,508 TB Raw and L0Ra Data
 - average scene size 1813 MB
- **ETM+: Landsat 7**
 - ◆ **2,099,494** scenes
 - ~ 1,950 TB Raw and L0Ra Data
 - average scene size 487 MB
- **TM: Landsat 4 & Landsat 5**
 - ◆ **2,272,949** scenes
 - ~ 1,140 TB Raw and L0Ra Data
 - average scene size 263 MB
- **MSS: Landsat 1 through 5**
 - ◆ **1,300,174** scenes
 - ~ 79 TB Raw and L0Ra Data
 - average scene size 32 MB
- **Total:**
 - ◆ **6,398,151** scenes
 - ~ 5,677 TB Raw and L0Ra Data



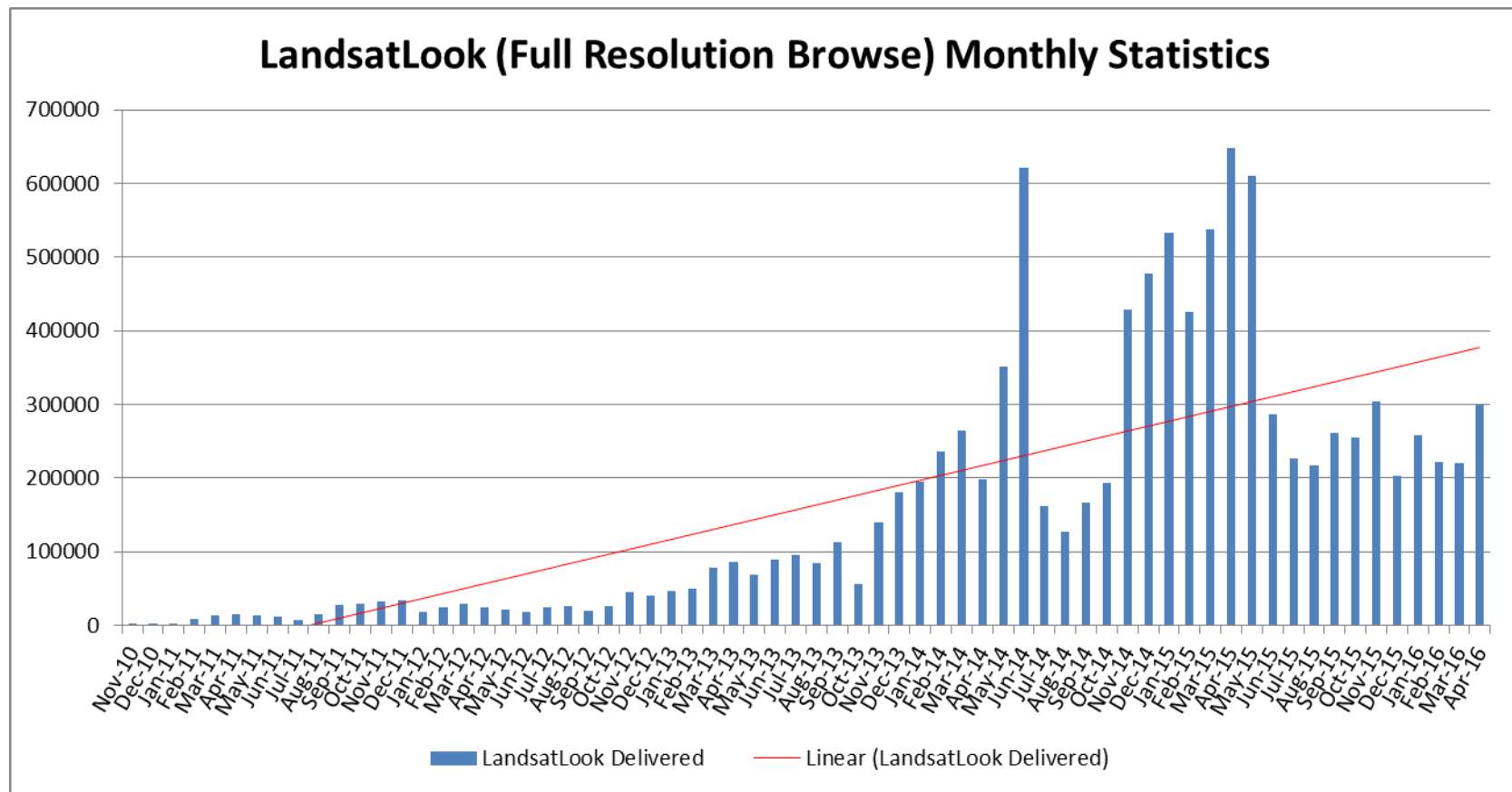
Monthly Downloads/Processed



	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16 (-Apr)
Scenes Delivered	1.1 M	2.5 M	2.9 M	2.7 M	4.3 M	6.8 M	8.8 M	10.6 M
Scenes Processed	.4 M	.6 M	1.3 M	1.8 M	3.3 M	4.2 M	2.8 M	1.9 M

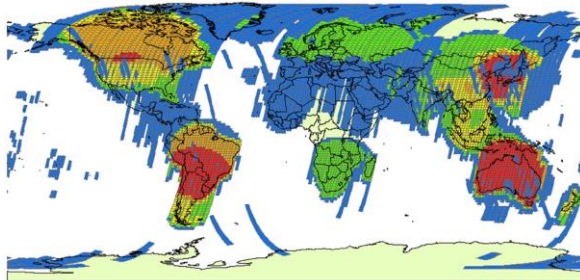


Monthly Full Resolution Browse Downloads

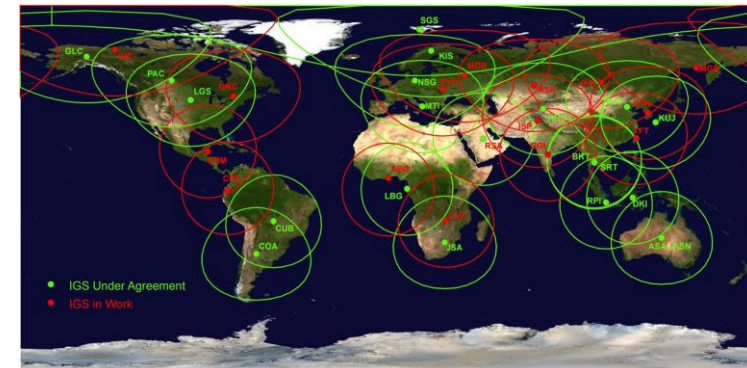


	FY11	FY12	FY13	FY14	FY15	FY16 (-Apr)
LL Delivered	.1 M	.3 M	.8 M	2.7 M	4.8 M	1.8 M

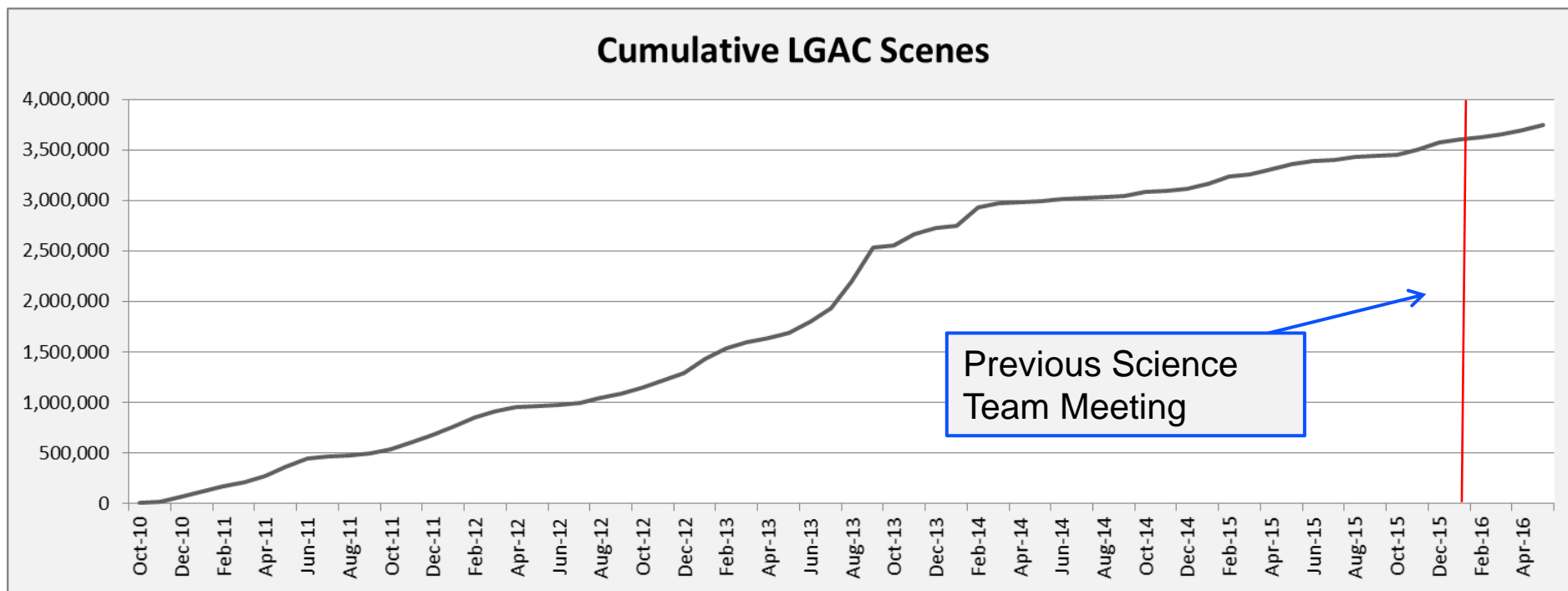
Landsat Global Archive Consolidation Status



LGAC WRS2 Scenes
Status as of September 30, 2015
Acquisition Date Range: August 22, 1982 through September 29, 2015
3,461,154 Cumulative Scenes Delivered
3,295,962 Total WRS2 Scenes Acquired
14,012 Unique WRS2 Path/Rows



Cumulative LGAC Status



Woodcock Metric: 3,745,686 scenes
(through April 2016)



LGAC Notional Timeline – TM

International Cooperator			TM					Notes / Notional Timeline (highlights are change from Winter 2016 LST meeting)
GSID	Country	Location	Actual	Estimate	% Comp.	Unique	% Unique	
BJC	China	Beijing	309,976	560,000	55%	300,160	97%	Anticipate completion of TM by end of 2017
BKT	Thailand	Bangkok	210,262	215,000	98%	193,472	92%	Anticipate completion of TM data on HDDTs by end of 2018
COA	Argentina	Cordoba	103,643	190,000	55%	96,185	93%	Anticipate completion of TM and ETM+ by end of 2016 mid-2017
CPE	Ecuador	Cotapaxi	25,246	50,000	50%	12,304	49%	Being worked; no anticipated date at this time
DKI	Indonesia	Parepare	17,017	32,000	53%	16,686	98%	Completion of TM data on DCRSi tapes could take some time due to mold problems on the tapes
FUI	Italy	Fucino	48	567,000	0%	48	100%	Anticipate completion of 1982-1986 and 2000-2001 TM data by end of 2016-2017; TM data from 1987-1999 have poor PCD - decision on how to handle this data is pending
IRK	Russia	Irkutsk	23,398	23,398	100%	23,353	100%	Completed
ISP	Pakistan	Islamabad	63,564	66,000	96%	61,842	97%	Completion of TM data on LTOs unknown at this time
JSA	South Africa	Hartebeesthoek	97,772	119,000	82%	84,843	87%	Anticipate completion of TM data by end of 2016
KHC	China	Kashi	30,639	30,639	100%	29,240	95%	Completed
KIS	Sweden	Kiruna	183,508	300,000	61%	180,755	98%	Outstanding TM data contains poor PCD (~40% of TM data holdings) - decision on how to handle data pending (1991-1996)
MGR	Russia	Magadan	2,970	2,970	100%	2,440	82%	Completed
MOR	Russia	Moscow	27,281	27,281	100%	26,554	97%	Completed
MPS	Spain	Maspalomas	16,329	50,000	33%	16,315	100%	Anticipate completion by end of 2016 2017
MTI	Italy	Matera	2,962	234,000	1%	2,941	99%	Anticipate completion by end of 2016 2017
RSA	Saudi Arabia	Riyadh	1,608	250,000	1%	860	53%	Completion of TM data on HDDTs could take multiple years
Totals			1,116,223	2,717,288	41%	1,047,998	94%	

ESA will finish reprocessing transcription activity this month. A new inventory list will be sent for reconciliation. Then all outstanding data will be shipped to US.

Additional information in the backup slides



Landsat Products & Collection Management

- **Definition Update**
- **Identification Update**
- **Data Management and Distribution**
- **Production Plans**
- **Publications / Status Updates**

Collection Definition Progress

- **3 Basic Categories (open access to all data)**
 - **NRT (Near-real time) – products that are processed using ancillary data such as predicted ephemeris or bumper mode parameters that may be improved by reprocessing**
 - **Tier 1 – products that meet the criteria for the collection definition (i.e. enable time-series stacking)**
 - ♦ **Adopted 12m RMSE for collection 1 as a result of definition document peer reviews**
 - **~1/2 of a Landsat TM/ETM+/OLI pixel**
 - **A bit more conservative for the first collection at 12M RMSE**
 - **Able to be met by the current processing system and ground reference database**
 - **Tier 2 – products that do not meet the criteria for the collection definition and have been processed using the best known ancillary data**

A single collection (i.e. “collection 1”) for all sensors as opposed to a separate collection per sensor

Updated Collection Definition Document Available



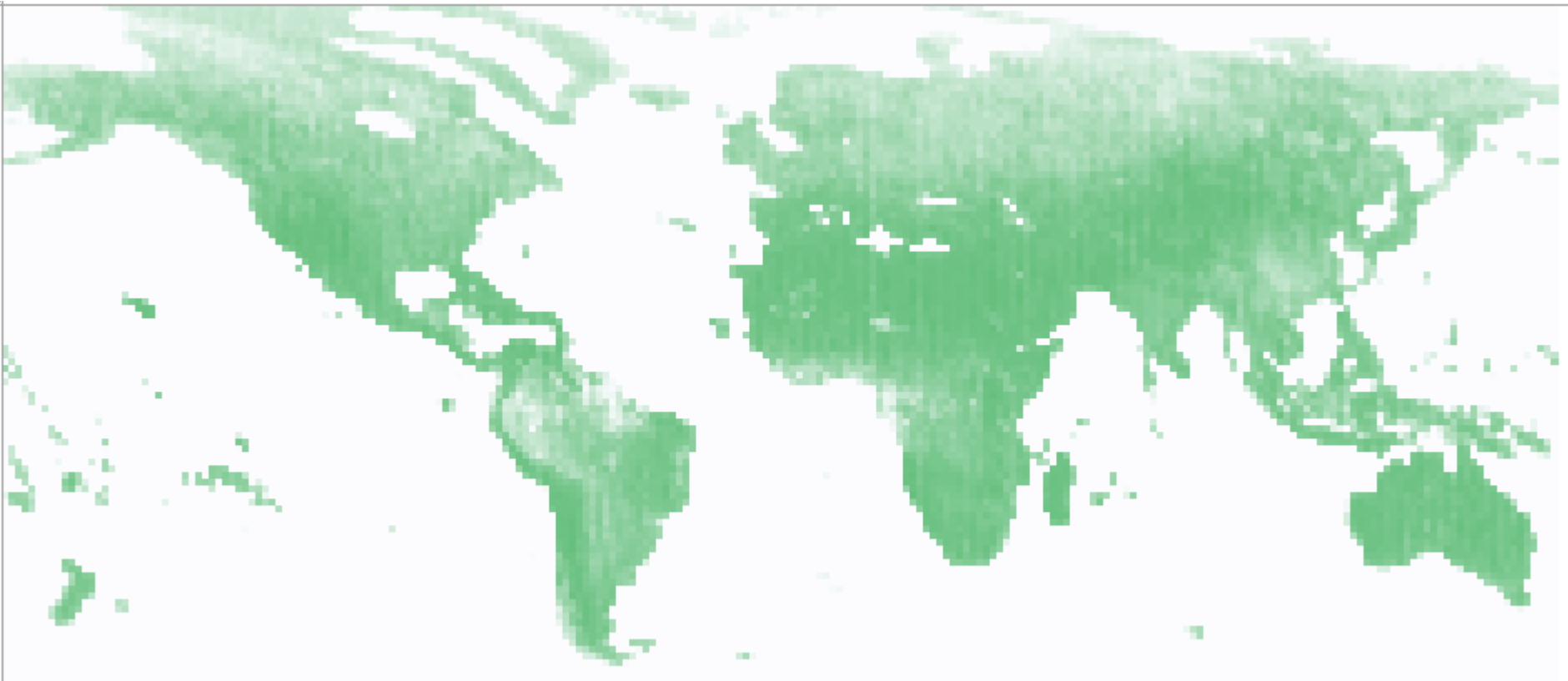
Collection 1 – Expected Tier-1 (12M RMSE)

Sensor/Tier	0<CCA<10	10<CCA<20	20<CCA<30	30<CCA<40	40<CCA<50	50<CCA<60	60<CCA<70	70<CCA<80	80<CCA<90	90<CCA<100	NIGHT	Grand Total
OLI												
L1T_Tier1	76.75%	69.34%	69.46%	68.01%	65.18%	60.78%	52.03%	41.72%	27.76%	16.84%	0.27%	60.42%
L1T_Tier2	6.26%	7.41%	6.62%	6.54%	6.31%	6.24%	5.87%	5.19%	4.10%	3.27%	0.22%	5.94%
L1GT_FB	2.94%	5.78%	7.50%	9.28%	12.22%	15.94%	22.77%	34.68%	49.71%	52.44%	7.78%	15.96%
L1GT	14.05%	17.47%	16.42%	16.16%	16.28%	17.04%	19.33%	18.41%	18.43%	27.44%	91.72%	17.69%
ETM												
L1T_Tier1	92.15%	89.63%	88.14%	86.05%	83.02%	77.12%	72.85%	62.66%	48.60%	19.01%	0.05%	75.17%
L1T_Tier2	1.26%	2.20%	2.55%	3.26%	3.40%	3.94%	4.04%	4.66%	4.91%	2.93%	0.10%	2.63%
L1GT_FB	1.58%	3.28%	4.82%	6.68%	9.78%	13.98%	17.93%	27.12%	44.42%	76.31%	20.34%	17.58%
L1GT	5.00%	4.85%	4.46%	3.97%	3.73%	4.93%	5.11%	5.49%	2.01%	1.64%	79.29%	4.57%
L1G_FB	0.01%	0.04%	0.02%	0.04%	0.06%	0.04%	0.07%	0.07%	0.06%	0.11%	0.00%	0.04%
L1G	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.21%	0.00%
TM												
L1T_Tier1	87.35%	82.26%	79.53%	77.89%	74.87%	69.29%	60.08%	45.32%	26.97%	12.93%	1.15%	65.41%
L1T_Tier2	1.84%	2.46%	2.98%	3.24%	3.78%	4.06%	4.26%	4.34%	3.54%	2.39%	0.23%	2.84%
L1G_FB	6.55%	9.97%	12.49%	14.60%	17.53%	22.99%	31.78%	46.08%	65.54%	81.46%	1.39%	27.54%
L1G	4.25%	5.31%	5.00%	4.28%	3.82%	3.66%	3.88%	4.26%	3.95%	3.22%	97.23%	4.21%
MSS												
L1T_Tier1	0.08%	0.05%	0.04%	0.05%	0.02%	0.03%	0.02%	0.02%	0.00%	0.00%	0.00%	0.05%
L1T_Tier2	68.71%	37.26%	26.93%	22.47%	18.36%	14.41%	12.55%	10.75%	9.37%	7.75%	0.65%	41.10%
L1G_FB	24.00%	50.24%	60.23%	63.17%	66.77%	70.74%	72.63%	73.01%	71.83%	66.00%	21.15%	46.09%
L1G	7.22%	12.45%	12.80%	14.31%	14.86%	14.82%	14.80%	16.22%	18.80%	26.25%	78.20%	12.76%

For <10m & <15m results see backup slides



WRS-2 Grid – OLI L1 Tier 1 Scene Density



Green indicates greatest temporal density



Collection Identification - File Name

- Additional information can be found at

<http://landsat.usgs.gov/landsatcollections.php#strategy>

(Collection File Name)

Scene ID

LXSPPPRRRRYYYYDDDGSI VV

L = Landsat
X = Sensor
S = Satellite
PPP = WRS path
RRR = WRS row
YYYY = Year
DDD = Julian day of year
GSI = Ground station identifier
VV = Archive version number

Examples:

LC80290302015343LGN00
LE70160392004262EDC02
LT40170361982320XXX08
LM10170391976031AAA01

Landsat Product Identifier

LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX

L = Landsat
X = Sensor ("C" = OLI/TIRS Combined, "O" = OLI-only, "T" = TIRS-only, "E" = ETM+, "T" = TM, "M" = MSS)
SS = Satellite ("07" = Landsat 7, "08" = Landsat 8)
LLLL = Processing correction level ("L1TP": Precision Terrain, "L1GT": Systematic Terrain, "L1GS": Systematic)
PPP = WRS path
RRR = WRS row
YYYYMMDD = Acquisition year (YYYY) / Month (MM) / Day (DD)
yyymmdd = Processing year (yyyy) / Month (mm) / Day (dd)
CC = Collection number ("01", "02")
TX = Collection category: ("RT" for Real-Time, "T1" for Tier 1, or "T2" for Tier 2)

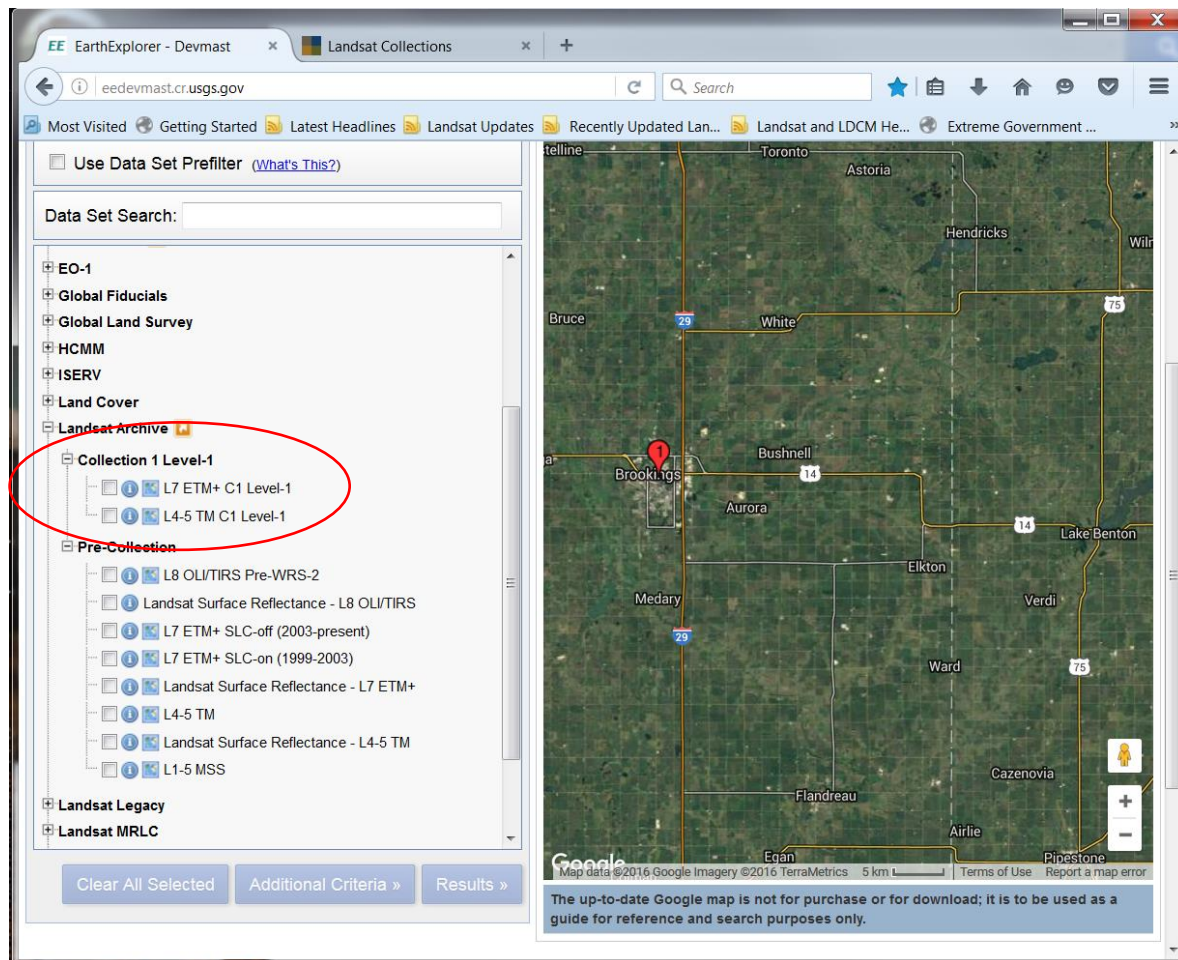
Examples:

LC08_L1GT_029030_20151209_20160131_01_RT
LE07_L1TP_016039_20040918_20160211_01_T1
LT04_L1GS_017036_19821115_20160315_01_T2
LM01_L1GS_017039_19760131_20160225_01_T2



Collection Data Management

- Resulted in changes to EE and pertinent metadata associated with collections
- Existing “pre-collection” is available



3. Additional Criteria (Optional)
If you have more than one data set selected, use the dropdown to select the additional criteria for each data sets.

Data Sets:
L4-5 TM C1 Level-1

Collection Category
All
Tier 1
Tier 2

Data Type Level-1
All
Level 1 TP
Level 1 GT
Level 1 GS

Spacecraft Identifier
All
Landsat 4
Landsat 5

Day/Night Indicator
All
Day
Night

Date L-1 Generated (Ex. YYYY/MM/DD)
to

Geometric RMSE Model (meters)
to

Landsat Scene Identifier (Legacy)

Reset All Criteria Results »

Collection 1: What's “IN” and “OUT”?

▪ Collection 1 Level-1 Product Changes

- Items **in** the Collection

- ♦ Collection File Name Change
- ♦ Quality Band
- ♦ Ground Control Library Updates - Phase I, II, and III
- ♦ TOA Reflectance Angle Coefficients
- ♦ Land Based Cloud Cover Score
- ♦ TIRS Stray Light Correction (discussion)
- ♦ Improved DEM over Greenland
- ♦ Reflectance based cross-calibration (mtl file updates)
- ♦ TM life-long gain adjustment

- Items **out** of the collection

- ♦ Level-1 data format change
 - Unable to settle on format change with community
 - Continued studies needed

Collection Publications Status

- Landsat Collections web page:
<http://landsat.usgs.gov/landsatcollections.php>
- Landsat 4-7 (TM, ETM+) Sample Products
 - Collection 1 Level-1 sample data products for Landsat 7 and Landsat 5 available - URL:
<http://landsat.usgs.gov/landsatcollections.php#sample>
- Landsat Headlines posted to
<http://landsat.usgs.gov/>
- Collection Definition Publication in Work



Collection 1 Schedule

- **Landsat 4-7**

- **Aug 9: Begin Production**
- **Aug 9 – 23: Operational Validation Period**
- **Aug 24: Open to the public**

- **Landsat 8**

- **Delayed due to TIRS Scene Select Mirror (SSM) alternative operations concept**
- **Data production releases kicked off in May 2016**
- **October 2016: Integration / Testing**
- **November 2016: Begin processing**
- **December 2016: Open to the public**



Production Plans

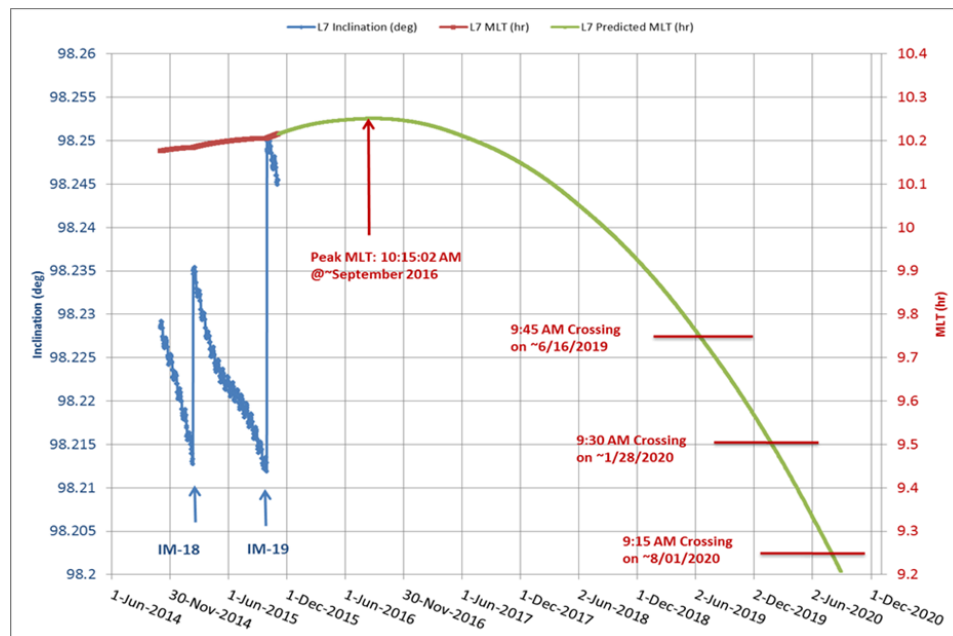
- **Plan to produce data in the following order**
 - **From newest to oldest data**
 1. **U.S. Data**
 2. **Rest of the Archive**
 - **TM/ETM+ in parallel end of July**
 - **OLI_TIRS in the fall**

Backup slides

- **Reference Slides for**
 - **Original L7 decommissioning approach**
 - **Additional detail on TIRS Side B analysis**
 - **Additional Collection 1 background information**
 - **LGAC status details**

For Reference – Original Approach

- Maximizes stewardship of orbit by dropping 20km to a disposal orbit of 685km
- Final inclination maneuver (delta-I) completed in October 2015
- 10:15 AM Mean Local Time (MLT) occurs September 2016 (peak MLT)
- 9:30 MLT occurs January 2020
- 9:15 MLT occurs Aug 2020 (End of Science Mission*)
- Approximately 2kg of fuel margin projected
 - Changed to 4kg in new approach in order to ensure ability to fully exit 705km orbit
- Results in approximately 9-15 month gap in 8-Day Landsat coverage (pending Landsat 9 LRD)

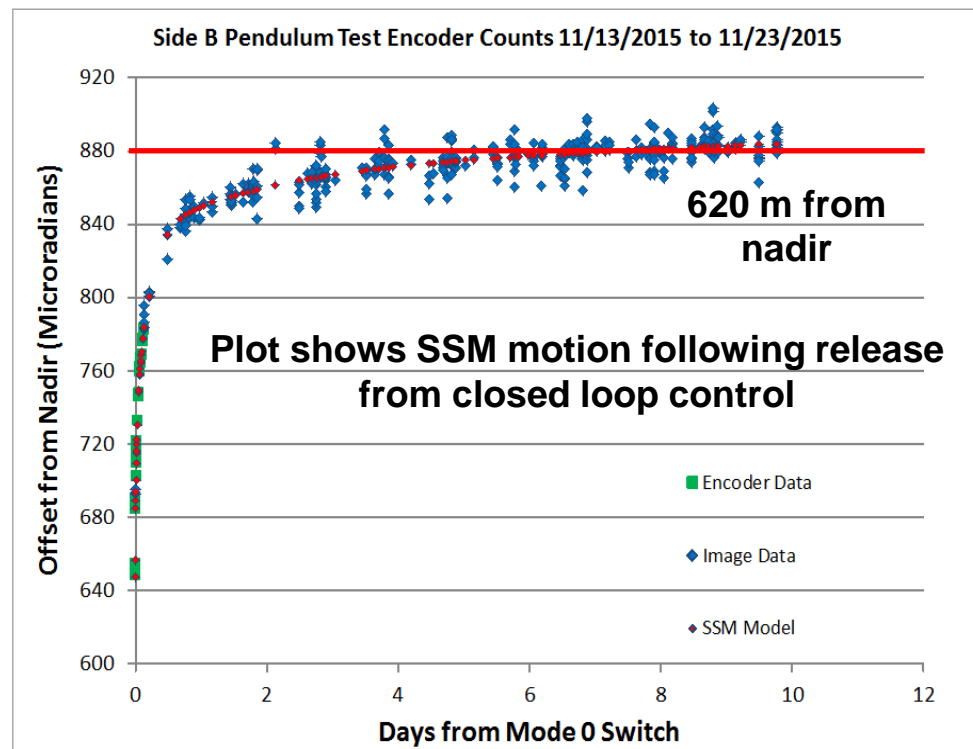


TIRS B-Side Alternative Ops Concept

- Landsat Mission Management determined that the most responsible and expedient decision is to remain on the B-side for long-term TIRS alternative operations

- ◆ Implementation of alternative TIRS operations concept includes reduced calibration events and development of a predictive model for drift of TIRS Scene Select Mirror (SSM)
- ◆ Effective April 2016 TIRS data now processed along with OLI


- Likely root cause identified by NASA ground testing



Demonstrates that the mirror drifts after the SSM current is turned off - is predictable.

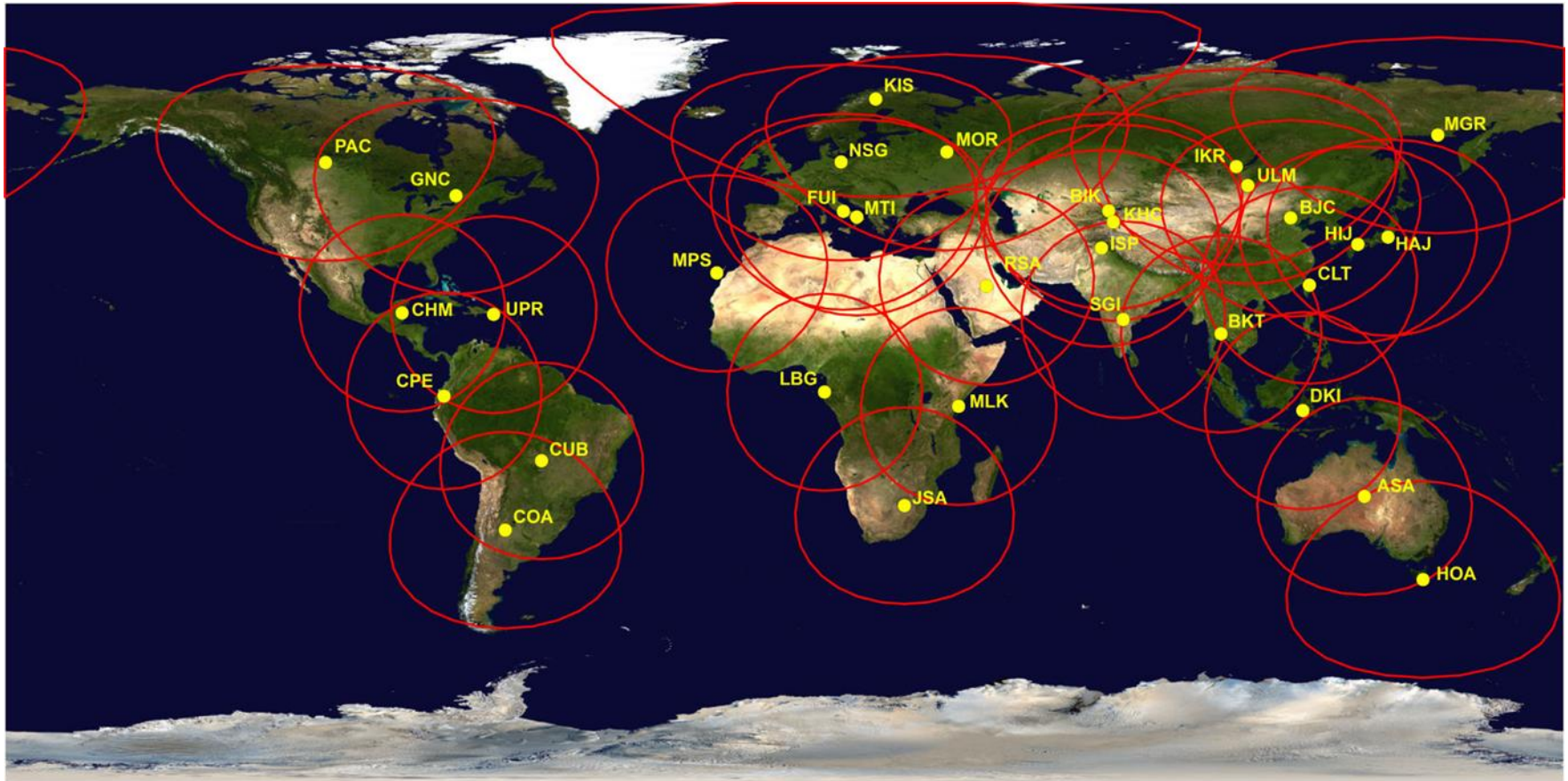
Collection 1 – Expected Tier 1

(10/15M RMSE for reference)

Instrument / Cloud Cover 	≤10%	≤20%	≤30%	≤40%	≤50%	≤60%	≤70%	≤80%	≤90%	≤100%	NIGHT	Grand Total
OLI												
L1T_<10m	72.30%	63.89%	64.98%	63.41%	60.88%	55.85%	45.86%	36.06%	23.78%	15.08%	0.05%	58.25%
10m<_L1T_<15m	6.80%	8.62%	7.96%	7.70%	7.37%	7.32%	6.60%	5.67%	3.85%	2.87%	0.09%	6.78%
L1T_>15m	3.18%	3.74%	3.42%	3.48%	3.26%	3.35%	3.07%	2.85%	2.58%	2.10%	0.14%	3.17%
L1GT_FB	2.87%	5.93%	7.41%	9.33%	12.07%	16.17%	24.23%	35.65%	50.57%	54.31%	7.62%	14.12%
L1GT	14.86%	17.83%	16.22%	16.06%	16.43%	17.32%	20.24%	19.76%	19.22%	25.63%	92.10%	17.68%
ETM												
L1T_<10m	90.65%	87.30%	85.23%	82.80%	79.52%	73.47%	68.85%	58.52%	45.26%	17.91%	0.06%	72.79%
10m<_L1T_<15m	1.83%	3.33%	4.19%	4.93%	5.33%	5.53%	5.62%	5.55%	5.47%	2.90%	0.00%	3.57%
L1T_>15m	0.59%	0.94%	1.05%	1.45%	1.56%	1.93%	2.15%	2.68%	2.83%	1.74%	0.00%	1.34%
L1GT_FB	1.67%	3.39%	5.02%	6.81%	9.89%	14.05%	18.11%	27.47%	44.49%	75.80%	22.35%	17.61%
L1GT	5.25%	5.00%	4.48%	3.96%	3.63%	4.97%	5.20%	5.72%	1.89%	1.55%	77.59%	4.65%
L1G_FB	0.01%	0.04%	0.03%	0.04%	0.07%	0.05%	0.07%	0.06%	0.06%	0.11%	0.00%	0.04%
L1G	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TM												
L1T_<10m	85.45%	80.39%	77.54%	75.36%	71.04%	63.67%	53.09%	37.57%	22.02%	10.37%	0.33%	63.02%
10m<_L1T_<15m	2.32%	2.84%	3.23%	3.45%	4.08%	4.24%	3.65%	3.61%	2.79%	2.54%	0.91%	2.96%
L1T_>15m	0.99%	1.15%	1.48%	1.69%	2.01%	2.23%	2.45%	2.24%	1.84%	1.05%	0.25%	1.44%
L1G_FB	6.71%	10.42%	12.88%	15.60%	19.20%	26.32%	36.67%	52.44%	69.81%	83.03%	71.43%	28.39%
L1G	4.53%	5.20%	4.87%	3.90%	3.67%	3.54%	4.15%	4.15%	3.55%	3.00%	27.09%	4.18%
MSS												
L1T_<10m	0.03%	0.01%	0.00%	0.02%	0.00%	0.02%	0.01%	0.00%	0.00%	0.00%	0.00%	0.02%
10m<_L1T_<15m	0.22%	0.20%	0.22%	0.22%	0.16%	0.14%	0.12%	0.05%	0.07%	0.02%	0.00%	0.17%
L1T_>15m	66.55%	34.58%	24.66%	21.07%	17.23%	13.45%	11.89%	9.92%	8.54%	7.40%	2.33%	40.41%
L1G_FB	27.01%	53.66%	62.71%	64.43%	67.93%	71.54%	73.11%	73.05%	71.00%	64.29%	23.25%	47.17%
L1G	6.20%	11.55%	12.41%	14.26%	14.68%	14.86%	14.88%	16.98%	20.39%	28.28%	74.42%	12.23%



Historical Landsat Ground Stations



* Does not include Landsat Ground Network (LGN) stations



LGAC Status

Country (Organization)	Ground Station	% LGAC Delivered	% LGAC Ingested
Argentina (CONAE)	COA	TM	TM
		ETM+	ETM+
Australia (GA-NEO)	ASA	MSS	MSS
		TM	TM
		ETM+	ETM+
Australia (GA-NEO)	HOA	TM	TM
		ETM+	ETM+
Brazil (INPE)	CUB	MSS	MSS
		TM	TM
		ETM+	ETM+
Canada (CCMEO)	GNC	MSS	MSS
		TM	TM
		ETM+	ETM+
Canada (CCMEO)	PAC	MSS	MSS
		TM	TM
		ETM+	ETM+

- **Argentina – LTOs**
 - TM and ETM+ data delivery continues
- **Brazil – HDDTs**
 - **USGS to investigate setting up Wideband Video Drive to read tapes**
 - ~875 tapes to be sent by Brazil upon sample tape success
 - Primarily consist of MSS data, with very small number of TM intervals also included



LGAC Status

Country (Organization)	Ground Station	% LGAC Delivered	% LGAC Ingested
China (RADI)	BJC	TM	TM
		ETM+	ETM+
China (RADI)	KHC	TM	TM
Ecuador (IEE)	CPE	TM	TM
Europe (ESA)	FUI	MSS	MSS
		TM	TM
		ETM+	ETM+
Europe (ESA)	KIS	MSS	MSS
		TM	TM
		ETM+	ETM+
Europe (ESA)	MTI	TM	TM
		ETM+	ETM+
Europe (ESA)	MPS	MSS	MSS
		TM	TM
		ETM+	ETM+
Europe (ESA)	NSG	ETM+	ETM+

- **China – Electronic data delivery**
 - TM data delivered in FRED format
- **Ecuador – All data has been received**
 - Addressing several problematic tapes
- **Europe – NAS HDs**
 - ~30 TB of ETM+ data recently received
 - USGS working with ESA to obtain updated metadata lists and aid in data reconciliation efforts
 - **USGS trending analysis pending for ~500,000 TM scenes with missing PCD**
 - **MSS data delivery pending**



LGAC Status

Country (Organization)	Ground Station	% LGAC Delivered	% LGAC Ingested
India (ISRO)	SGI	TM	TM
		MSS	MSS
Indonesia (LAPAN)	DKI	TM	TM
		ETM+	ETM+
Japan (HIT/HEEIC)	HIJ	ETM+	ETM+
Japan (JAXA/RESTEC)	HAJ	MSS	MSS
		TM	TM
		ETM+	ETM+
Kyrgyzstan (DLR)	BIK	TM	TM
Mongolia (DLR)	ULM	TM	TM
Pakistan (SUPARCO)	ISP	MSS	MSS
		TM	TM
Russia (ScanEx)	IKR	TM	TM
Russia (ScanEx)	MGR	TM	TM
Russia (ScanEx)	MOR	TM	TM

- **India – All data has been received**
 - MSS data was only available in partially processed Level 1 format
 - USGS to assess options for data archival and distribution
- **Indonesia – All data has been received**
 - DCRSi drive parts needed for remaining tapes
 - USGS working with commercial vendor on potential tape cleaning solution
- **Pakistan – All HDDTs have been received**
 - HDDT reading completed
 - Delivery of additional TM data on LTOs pending
- **Russia – Electronic data delivery**
 - Identified approximately 40,000 TM scenes that had not previously been delivered to USGS in support of the GLS campaigns



LGAC Status

Country (Organization)	Ground Station	% LGAC Delivered	% LGAC Ingested
Saudi Arabia (KACST)	RSA	MSS	MSS
		TM	TM
South Africa (SANSA)	JSA	MSS	MSS
		TM	TM
		ETM+	ETM+
Taiwan (CSRSR-NCU)	CLT	TM	TM
Thailand (GISTDA)	BKT	MSS	MSS
		TM	TM
		ETM+	ETM+
US (U of Puerto Rico)	UPR	ETM+	ETM+

- **Saudi Arabia – All HDDTs and DLTs have been delivered**
 - MSS and TM data
 - Data from multiple sensors identified on media
 - KACST to obtain written approval for reading the non-Landsat data
- **South Africa – Electronic data delivery**
 - Delivery of MSS data pending
- **Thailand – All data has been delivered**
 - HDDT tape baking, cleaning, reading, and ingest currently in progress

LGAC Status Summary

(for your reference)

GSID	Country	Location	Scenes Ingested Since Sept. 2010														
			MSS					TM					ETM+				
			Actual	Estimated	% Comp	Unique	% Unique	Actual	Estimated	% Comp	Unique	% Unique	Actual	Estimated	% Comp	Unique	% Unique
ASA	Australia	Alice Springs	223,791	224,000	100%	166,582	74%	184,963	185,000	100%	181,058	98%	207,262	205,000	100%	112,177	54%
BIK	Kyrgyzstan	Bishkek						2,340	2,000	100%	1,749	75%					
BJC	China	Beijing						276,063	560,000	49%	269,852	98%	116	47,000	0%	17	15%
BKT	Thailand	Bangkok	0	57,000	0%	0	0%	208,459	215,000	97%	195,551	92%	18,704	18,000	100%	8,268	44%
CLT	Taiwan	Chung Li						11,586	12,000	97%	11,297	98%					
COA	Argentina	Cordoba						103,643	190,000	55%	96,185	93%	131,078	195,000	67%	55,530	42%
CPE	Ecuador	Cotapaxi						25,246	50,000	50%	12,304	49%					
CUB	Brazil	Cuiaba	0	76,000	0%	0	0%	306,704	307,000	100%	263,745	86%	96,672	96,000	100%	55,152	57%
DKI	Indonesia	Parepare						17,017	32,000	53%	16,686	98%	56,364	56,000	100%	24,908	44%
FUI	Italy	Fucino	0	2,000	0%	0	0%	48	567,000	0%	48	100%	0	51,000	0%	0	0%
GNC	Canada	Gatineau						53,019	53,000	100%	14,681	28%	37,955	38,000	100%	9,988	26%
HAI	Japan	Hatoyama	158,352	158,000	100%	95,208	60%	131,556	132,000	100%	127,107	97%	20,556	21,000	98%	10,667	52%
HIJ	Japan	Hiroshima											39,365	39,000	100%	15,316	39%
HOA	Australia	Hobart						5,812	6,000	97%	5,767	99%	13,110	13,000	100%	5,255	40%
ISP	Pakistan	Islamabad	410	400	100%	410	100%	63,564	66,000	96%	61,842	97%					
JSA	South Africa	Hartebeesthoek	0	18,000	0%	0	0%	97,772	119,000	82%	84,843	87%	30,747	31,000	100%	9,000	29%
KHC	China	KaShi						30,639	30,000	100%	29,240	95%					
KIS	Sweden	Kiruna	0	432,000	0%	0	0%	183,508	300,000	61%	180,755	98%	28,592	43,000	66%	17,764	62%
MPS	Spain	Maspalomas	0	154,000	0%	0	0%	16,329	50,000	33%	16,329	100%	7,480	32,000	24%	4,099	55%
MTI	Italy	Matera						2,962	234,000	1%	2,941	99%	27	48,000	0%	3	15%
NSG	Germany	Neustrelitz	5,132	5,000	100%	5,102	99%						17,948	88,000	20%	9,806	55%
PAC	Canada	Prince Albert	414,418	414,000	100%	201,692	49%	369,715	370,000	100%	193,020	52%	100,374	100,000	100%	28,671	29%
RSA	Saudi Arabia	Riyahd	0	5,000	0%	0	0%	1,608	250,000	1%	860	53%					
SGI	India	Shadnagar	0	12,000	0%	0	0%	38,404	39,000	100%	38,054	99%					
ULM	Mongolia	Ulan Bator						556	500	111%	554	100%					
UPR	Puerto Rico	Mayaguez											315	500	63%	118	37%
Totals			802,103	1,557,400	52%	468,994	58%	2,131,513	3,769,500	57%	1,774,468	83%	806,665	1,121,500	72%	366,739	45%

Almost 3.75 million scenes ingested!

Approximately 59% complete

Approximately 69% of scenes are new to the archive!

• Includes partial scenes

• **Green = Completed**

